Claims

1. Image-generating energy filter for electrically charged particles such as electrons and ions with at least two toroidal energy analyzers arranged in a row, where at least one energy analyzer has a diaphragm at its entrance plane and another diaphragm at its exit plane, characterized in that

   a transfer lens device (20, 20') is located between the exit plane (5) of the first energy analyzer (30, 30', 30") and the entrance plane (6) of the second energy analyzer (40, 40', 40"), which device has negative lateral magnification V_L, negative angular magnification V_W, image rotation around the angle $\gamma = \beta - 180°$, and a telescopic beam path, where its respective deflection angles ϕ are equal and its energy-dispersive planes (33, 43) are rotated around the angle β with respect to each other.

2. Energy filter according to Claim 1, characterized in that the transfer lens device (20, 20') is designed so that, in the energy-dispersive plane (33), it projects the intermediate image ZB_1 (23) present at the exit plane (5) of the first energy analyzer (30, 30', 30") with a linear magnification of

   $V_L = \frac{ZB_2}{ZB_1} < 0$ and with an angular magnification of $V_W = \frac{\alpha_2}{\alpha_1} < 0$ where

   $V_W V_L \sqrt{\frac{E_2}{E_1}} = 1$, rotated around the angle γ, onto the entrance plane (6) of the second energy analyzer (40, 40', 40") as intermediate image ZB_2 (24),

   where α_1 is the exit angle of the charged particles from the exit plane (5) of the first energy analyzer (30, 30', 30"); α_2 is the entrance angle to the entrance plane (6) of the second energy analyzer (40, 40', 40"); E_1 is the kinetic energy of the charged particles in the exit plane of the first energy analyzer (30, 30', 30"); and E_2 is the kinetic energy of the

charged particles in the entrance plane of the second energy analyzer (40, 40', 40"), and
where the charged particles in the transfer lens device (20, 20') pass through a telescopic beam path.

3. Energy filter according to Claim 1 or Claim 2, characterized in that the energy analyzers (30, 30', 30"; 40, 40', 40") and the transfer lens device (20) are arranged with point symmetric around the center of the transfer lens device.

4. Energy filter according to Claim 1 or Claim 2, characterized in that the energy analyzers (30, 30', 30"; 40, 40', 40") are built with different dimensions.

5. Energy filter according to one of Claims 1-4, characterized in that the energy analyzers are spherical sectors (30', 40'), hemispherical analyzers (30, 40), or cylindrical analyzers (30", 40").

6. Energy filter according to Claim 5, characterized in that the energy-dispersive planes (33, 43) of the hemispherical analyzers (30, 40) are rotated around the axis (200) of the transfer lens device (20) by the angle $\beta = 180°$, so that the beam path has a the shape of an "S".

7. Energy filter according to one of Claims 1-6, characterized in that the transfer lens device (20) comprises at least one electrostatic tube lens (21, 22).

8. Energy filter according to one of Claims 1-7, characterized in that the transfer lens device (20') comprises at least one magnetic lens.

9. Energy filter according to one of Claims 1-8, characterized in that the transfer lens device (20) comprises at least one multipole lens (121, 122).

10. Energy filter according to one of Claims 1-9, characterized in that the transfer lens device (20) has at least two lenses (21, 21') and (22, 22'), and in that the exit plane (5) of the first energy analyzer (30, 30', 30") is located at the focal point of the first lens (21, 21') and the entrance plane (6) of the second energy analyzer (40, 40', 40") is located at the focal point of the second lens (22, 22'), where the distance between the two lenses is 2F, where F stands for the focal distance of the lenses (21, 22, 21', 22').

11. Use of an energy filter according to one of Claims 1-10 for electron microscopes.

12. Use of an energy filter according to one of Claims 1-10 for time-resolved measuring instruments.